# RESPONSE SEEDS PRODUCTION OF BROAD BEAN TO FOLIAR SPRAY WITH MAGNESIUM AND BORON

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**ABSTRACT**

**The experiment was carried out during winter season of 2019-2020 at the fields of directorate of seed testing and certification. This experiment was designed as RCBD factorial experiment included studying the effect of foliar application of four levels of magnesium at 0, 1, 2 and 3 g.l$^{-1}$ and three levels of boron at 0, 100, and 200 mg.l$^{-1}$ foliar application and their interactions on broad bean genotype LUZ DE OTONO dry seeds yield and its characteristics and to determine the treatments effect on quality and germination percentage of produced seeds from the filed study. Results showed that concentrations of Magnesium spray at 1 g.l$^{-1}$ was superior on dry seed yield while boron spray with 100 mg.l$^{-1}$ was superior in dry pods number, dry seeds weight, dry seeds yield, 100 seeds weight, pods width, protein percentage in dry seeds and seeds germination. There can we recommended that the utilization of foliar application at magnesium 1 g.l$^{-1}$ and boron at 100 mg.l$^{-1}$ improved yield and dry seeds qualities.**

**Keyword: dry seeds yield, protein, germination, feeding.**



## استجابة انتاجية البذور في الباقلاء للرش الورقي بالمغنيسيوم والبورون

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**المستخلص**

**اجريت تجربة حقلية في دائرة فحص وتصديق البذور حقول محطة ابحاث ابي غريب، خلال الموسم الخريفي 2019−2020 على نبات الباقلاء صنف LUZ DE OTONO لدراسة تأثير الرش الورقي بأربعة تراكيز من المغنيسوم وثلاث تراكيز من البورون وتداخلاتهم في حاصل البذور الجافة وبعض خصائصها، استعملت تجربة عاملية وفق تصميم القطاعات العشوائية الكاملة باستعمال كبريتات المغنيسوم بالتراكيز (0، 1، 2، 3) غم.لتر$^{-1}$ بينما تم رش حامض البوريك بالتراكيز (0، 100، 200) ملغم.لتر$^{-1}$ ولبيان تأثير المعاملات على نوعية ونسبة انبات البذور المنتجة من التجربة الحقلية. بينت النتائج تفوق معاملة المغنيسوم 1 غم.لتر$^{-1}$ معنويا في حاصل البذور الجافة وفي وزن 100 بذرة وتفوقت معاملة البورون 100 ملغم.لتر$^{-1}$ في عدد القرنات الجافة ووزن البذور الجافة وحاصل البذور الجافة ووزن 100 بذرة وعرض القرنة ونسبة البروتين والنسبة المئوية للانبات وتفوقت المعاملات الاخرى في الصفات المتبقية مقارنة مع معاملة المقارنة.ويمكن ان نوصي بتطبيق التغذية الورقية بتركيز 1 غم.لتر$^{-1}$ كبريتات المغنيسيوم و 100 ملغم.لتر$^{-1}$ حامض البوريك لتحسين نوعية وحاصل البذور الجافة.**

**الكلمات المفتاحية: حاصل البذور الجافة، البروتين، الانبات، التغذية.**

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## INTRODUCTION

Faba bean, also commonly known as broad bean, is a species of flowering plant included in the Fabaceae family (34). Algeria is the origin country of broad bean and it also grows widely in North Africa and South West Asia the cultivation of broad bean is spread throughout the world and it’s widely grown in Iraq (26). Dry seeds contain 21%protein, 48% starch, 3% fat, 2% glucose, 3% mineral salts and 23% of other substances. It considered a complete food supplement and it has the similar nutritional supplements as meat. In arid areas the dry seeds are stored to be used during winter and other seasons, the weight of 100 seeds amount in 80-120g for small-seeds varieties and 200g for large-seeds varieties, it require a long day and grow at a temperature of 14 c˚ (13). Leaf-applied fertilizes has been proven to be a valuable complement to soil fertilization under certain circumstances (29). Supply of foliar nutrients can lead to a rapid improvement of the nutritional status of plants under deficiency conditions (12). During the stages of growth the processing of macro and micro nutrients is very important for plant growth and development. Therefore, the lack of such nutrients lead to poor quality of yield and a significant growth deficit (9).

Magnesium in plant cells has a specialize function in activation of photosynthesis, respiratory enzymes, and the synthesis of RNA and DNA. Magnesium ions are also involved in the construction of chlorophyll (16). The concentration of both photosynthesis and chlorophyll increased after the foliar application of magnesium applied to broad bean (15). Magnesium has a biological and physiological effect in plants such as photophosphorylation, acid formation, protein creation, green plastid enzymes, carbon dioxide stabilization, chlorophyll formation, and activation of enzymes that play a role in photosynthesis, and important for the stabilization of cell membrane (7) .Boron is essential for pollination and fertilization by extending the pollen tube, and developing fruits and seeds (8). Boron plays a role in cell elongation, DNA representation, hormone response, and it is important in cell’s regulating (33). The importance of boron is also well recognized in different physiological processes in plants and it seems to exert different effects such as root elongation, indole acetic acid oxidase, sugar translocation, carbohydrate metabolism, nucleic acid synthesis and pollen tube growth (14). Boron has a vital effect in production of seeds to the extent that make plant under severe boron deficiency fail to produce factional flowers and may produce no seeds (25). It was noted that pea plants with boron deficiency has a negative impacts on seeds quality and productivity, despite the increased concentration of sugars and starch (17). The objective of this present experiment was to examine the effect of Magnesium and Boron on characteristics of dry seeds production of broad bean.

## MATERIALS AND METHODS

**Field experiment:** A field experiment was carried out at the fields of seeds testing and certification directorate in Abu Ghraib research station, Baghdad, Iraq during the winter season of 2019-2020 to determine the effect of foliar application with magnesium and boron on seeds yield and it's components. Broad bean seeds cv. LUZ DE OTONO produced by Semillas Fito the seeds were planted in 13/10/2019 after dividing the field land into pinchs with 75 cm apart and 30 cm between plants which total 2.25 $m^2$ as experimental unit area. This experiment included 12 treatments (4 concentrations of Mg × 3 concentrations of B) with three replicates. Each experimental unit consisted of 10 plants. In addition, two pinch guards were added for each replicate to prevent mechanical and human damage to the experiment. Recommended fertilization was followed at 100 kg N, 120 kg $P_2O_5$ and 40 kg $K_2O$ per hectare (3). The factorial experiment was implemented with Randomized Complete Block Design (RCBD).

**First Factor**: Spraying Magnesium with concentrations at 0, 1, 2, and 3 $g.L^{-1}$ as magnesium sulphate $MgSO_4.7H_2O$ (10% mg) with three spatial sprays in 16/11/2019, 4/12/2019, and 22/12/2019.

**Second Factor**: Spraying Boron with 0-100-200 $mg.L^{-1}$ as boric acid $H_3BO_3$ (17.4% B) with two spatial sprays in 19/11/2019 and 8/12/2019.

**Table 1. physical and chemical Properties of agricultural soil**

| Properties | Value | Unite |
|---|---|---|
| EC | 2.92 | $ds.m^{-1}$ |
| PH | 7.87 | -- |
| Nitrogen | 48.13 | $mg.\ kg^{-1}$ |
| Phosphor | 11.09 | $mg.\ kg^{-1}$ |
| Potassium | 181.73 | $mg.\ kg^{-1}$ |
| Magnesium | 14.67 | $mg.\ kg^{-1}$ |
| Boron | 0.43 | $mg.\ kg^{-1}$ |
| Clay | 34.20 | % |
| Silt | 39.50 | % |
| Sand | 26.30 | % |

**Yield characters**

1- Dry pods number ($pod.plant^{-1}$).
2- Seeds number per pod ($seed.Pod^{-1}$).
3- Weight of dry seeds ($g.pods^{-1}$).
4- Dry seeds yield ($g.plant^{-1}$).
5- Weight of 100 seeds (g).
6- Pods width
7- Pods length.
8- Protein percentage (%): protein percentage was calculated by multiplying the nitrogen percentage by 6.25 total nitrogen content in seeds which was estimated by using micro kjeldahl (2).
9- Germination percentage (%):
Was determined according to ISTA (20).

**Germination (%)** = Number of germinated seeds / Number of total seeds × 100

**Statistical analysis**

Results were analyzed according to statistical Genstat Discovery Edition program and means were compared by least significant difference (LSD) with (5%) probability level (5)

**RESULTS AND DISCUSSION**

**Response of seeds production of broad bean to magnesium foliar spray:** Data in table 3 shows that magnesium treatment at 1000 $mg.l^{-1}$ significantly affect seeds production traits which give the highest dry seeds yield and 100 seeds weight amounted 179.66 $g.Plant^{-1}$ and 165.73 g, respectively with an increase of 19.44%, and 7.72%, respectively compared to control. In addition, Table 4 indicates that magnesium treatment at 2000 $mg.l^{-1}$ significantly increased seeds germination percentage which give the highest value and reached 57.56% with an increase of 32.43% compared to control treatment. Data in Table 2 and 3 demonstrated that magnesium application at 3000 $mg.l^{-1}$ was significantly effective in dry seeds weight and protein percentage in dry seeds which gave 5.04 $g.Pod^{-1}$ and 19.08% with an increase by 6.54% and 7.38%, respectively compared to control treatment. The results fall in same line with the findings of Howladar et al. (19) which showed that magnesium significantly increased number of branches, number of pods, 100 seeds weight and pea seeds yields. Moreover, Neuhaus (28) also found that magnesium increased seeds yield under foliar Mg application in addition to improving seeds quality due to increasing protein content. The results consist with Jarecki et al. (21) that indicated foliar application with magnesium significantly increased protein percentage in seeds. The results were also consist with Saaseea and Al-a'amry (30) whom found a significant effect on growth of potato plant and protein percentage on its tuber. The positive effect of magnesium treatment on seeds yield and its components it could be attributed to its role in enhance chlorophyll molecule and therefore plays a fundamental effect in photosynthesis (32). In addition, many metabolic processes are directly affected by magnesium availability, these include many enzymatic reactions of photosynthesis, ribonucleic acid polymerization and adenosine triphosphate synthesis (22). Magnesium affects protein biosynthesis and plays a key role in carbohydrate partitioning, deficiency of magnesium has reduce the seeds quality due to its effect on protein concentration (27).

**Response of seeds production of broad bean to boron foliar spray:** Results in Tables 2, 3, and 4 show that boron treatment at 100 $mg.l^{-1}$ give a significant increase in most of other treatments which give the highest number of dry pods, weight of dry seeds, dry seeds yield, weight of 100 seeds, protein percentage in seeds, and germination percentage amounted to 14.68 $pods.Plant^{-1}$ and 5.12 $g.Pod^{-1}$ 185.09 $g.Plant^{-1}$ 164.68 g, 20.32% and 60% cm with an increase of 19.00%, 8.20%, 26.68%, 5.85%, 12.15%, 19.45%, respectively compared to control treatment. Data in Table 3 shows that boron treatment at 200 $mg.l^{-1}$ is significantly superior in seeds number of pods that give 4.626 seeds per pod with an increase of 5.77% compared to control treatment. The results is similar to the results of Alisawi and Khrbeet (4) who noticed that an increase in dry seeds yield of broad bean plant when sprayed with boron. The results is fall in the same line with El-Yazied and Mady (10) whi noticed an increase in seeds protein percentage, seeds number in the pod, weight of 100 seeds and seeds yield of the plant when treated with boron foliar application. This is consistent with Fadhil and Jader (11) that observed also an increased number of seeds in pods, weight of 100 seeds and seeds yield of the broad bean plant treated with boron. The result consistent with Mosleh and Abdul Rasool (24) whom found that spraying boron on pepper plants improved seeds quality. It could be concluded that the significant effect of boron on seeds characters due to its transport of carbohydrate materials from source to sink which give a greater chance to reduce competition (6). This is reflected in the facilitation of nutrition flux to the seeds due to boron foliar application that holds the dry seeds to its superiority in the average number of pod which enhanced seeds development (31). The superiority of boron in increasing protein percentage in dry seeds may be attributed to the role of boron in the process of protein synthesis through its importance in nitrogen fixation as well as through its influence in the process of formation of RNA (23). The positive effect of boron on dry seeds due to involving in flowering and cell division processes and aid the germination and growth of pollen tube (1). Boron deficiency predominantly damages actively growing organs such as shoot and root tips and effects flower retention, pollen formation, pollen tube growth or germination, nitrogen fixation and nitrate assimilation (18).

**Response of seeds production of broad bean to interaction of magnesium and boron:** According to data in tables 2 and 3, results shows that interaction treatment magnesium and boron at 1000 mg.l$^{-1}$ with 100 mg.l$^{-1}$ was significantly superior in seeds production which had the highest number of dry pods, dry seeds weight, dry seeds yield and 100 seeds weight at 17.57 pods.Plant$^{-1}$, 5.49 g.Pod$^{-1}$, 210.27 g.Plant$^{-1}$ and 175.40 g, respectively with an increases over control treatment of 38.36%, 19.85%, 49.06% and 16.24%, respectively. Table 4 shows that the interaction treatment between 2000 mg.l$^{-1}$ with 100 mg.l$^{-1}$ was significantly superior which give the highest protein content in dry seeds of 21.33% with an increase by 23.20% compared to control treatment. However, result in Table 4 indicates that the interaction between magnesium and boron at 3000 mg, l$^{-1}$ with 100 B mg.l$^{-1}$ was significantly superior which give highest germination rate of 68% with an increase of 51.95% compared to control treatment.

**Table 2. Effect of foliar spray of Magnesium Boron and their interaction on dry pods number, seeds number and dry seeds weight**

| | dry pods number (pod.plant$^{-1}$) | | | | seeds number (seeds.pod$^{-1}$) | | | | dry seeds weight (g.pods$^{-1}$) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B 0 | B 100 | B 200 | Mean | B 0 | B 100 | B 200 | Mean | B 0 | B 100 | B 200 | Mean |
| Mg 0 | 10.83 | 13.20 | 12.30 | 12.11 | 4.333 | 4.288 | 4.765 | 4.462 | 4.40 | 5.12 | 4.62 | 4.71 |
| Mg 1 | 10.80 | 17.57 | 14.46 | 14.27 | 4.245 | 4.410 | 4.610 | 4.422 | 4.80 | 5.49 | 4.64 | 4.98 |
| Mg 2 | 13.23 | 14.43 | 11.63 | 13.10 | 4.366 | 4.464 | 4.580 | 4.470 | 4.97 | 4.66 | 5.25 | 4.96 |
| Mg 3 | 12.70 | 13.50 | 14.13 | 13.44 | 4.490 | 4.521 | 4.547 | 4.520 | 4.65 | 5.21 | 5.25 | 5.04 |
| Mean | 11.89 | 14.68 | 13.13 | | 4.359 | 4.421 | 4.626 | | 4.70 | 5.12 | 4.94 | |
| L.S.D | Mg | B | Interaction | | Mg | B | Interaction | | Mg | B | Interaction | |
| 0.05 | N.S. | 1.303 | 2.606 | | N.S. | 0.173 | N.S. | | 0.210 | 0.182 | 0.364 | |

**Table 3. Effect of foliar spray of Magnesium Boron and their interaction on dry seeds yield, 100 seeds weight and pods width**

| | dry seeds yield (g.plant$^{-1}$) | | | | 100 seeds weight(g) | | | | pods width (cm.plant$^{-1}$) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B 0 | B 100 | B 200 | Mean | B 0 | B 100 | B 200 | Mean | B 0 | B 100 | B 200 | Mean |
| Mg 0 | 107.11 | 179.13 | 147.93 | 144.72 | 146.91 | 162.17 | 149.72 | 152.93 | 1.43 | 1.73 | 1.68 | 1.70 |
| Mg 1 | 125.32 | 210.27 | 203.38 | 179.66 | 158.31 | 175.40 | 163.48 | 165.73 | 1.73 | 1.88 | 1.63 | 1.75 |
| Mg 2 | 192.22 | 193.67 | 124.78 | 170.22 | 171.11 | 154.85 | 163.67 | 163.21 | 1.91 | 1.69 | 1.67 | 1.76 |
| Mg 3 | 118.09 | 157.31 | 187.94 | 154.45 | 143.83 | 166.30 | 161.41 | 157.18 | 1.67 | 1.77 | 1.68 | 1.62 |
| Mean | 135.69 | 185.09 | 166.01 | | 155.04 | 164.68 | 159.57 | | 1.75 | 1.77 | 1.61 | |
| L.S.D | Mg | B | Interaction | | Mg | B | Interaction | | Mg | B | Interaction | |
| 0.05 | 5.59 | 22.16 | 44.32 | | 7.69 | 6.66 | 13.33 | | N.S. | 0.1231 | N.S. | |

**Table 4. Effect of foliar spray of Magnesium Boron and their interaction on pods length, Protein percentage and Seeds Germination**

| | pods length (cm.plant$^{-1}$) | | | | Protein percentage (%) | | | | Seeds Germination (%) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B 0 | B 100 | B 200 | Mean | B 0 | B 100 | B 200 | Mean | B 0 | B 100 | B 200 | Mean |
| Mg 0 | 16.03 | 18.07 | 18.27 | 17.45 | 16.38 | 18.58 | 18.06 | 17.67 | 32.67 | 46.67 | 37.33 | 38.89 |
| Mg 1 | 19.20 | 19.95 | 18.17 | 19.11 | 21.13 | 20.25 | 15.52 | 18.97 | 42.00 | 66.00 | 52.67 | 53.56 |
| Mg 2 | 19.68 | 18.85 | 19.02 | 19.18 | 16.40 | 21.33 | 18.13 | 18.62 | 62.67 | 59.33 | 50.67 | 57.56 |
| Mg 3 | 19.00 | 18.82 | 18.57 | 18.79 | 17.50 | 21.13 | 18.63 | 19.08 | 56.00 | 68.00 | 46.67 | 56.89 |
| Mean | 18.48 | 18.92 | 18.50 | | 17.85 | 20.32 | 17.58 | | 48.33 | 60.00 | 46.83 | |
| L.S.D 0.05 | Mg | B | Interaction | | Mg | B | Interaction | | Mg | B | Interaction | |
| | N.S. | N.S. | N.S. | | 1.049 | 0.908 | 1.817 | | 7.15 | 6.19 | 12.38 | |

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